Micro PLCs

Small, rugged programmable logic controllers (PLCs) are among the fastest-growing areas of control logic. Programmable automation controllers (PACs) serve similar functions with different options.

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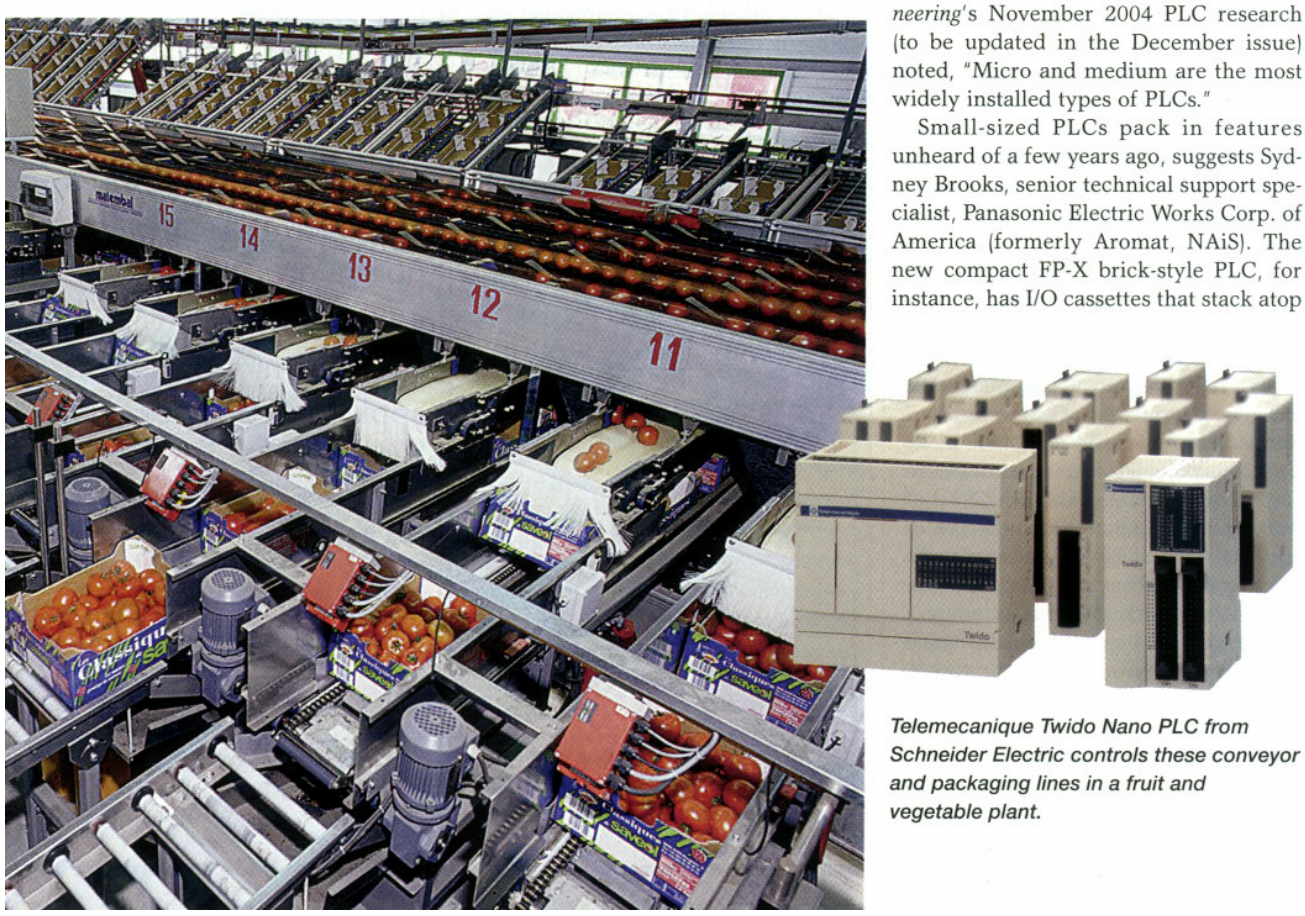
So do you need a micro PLC or a PAC (programmable automation controller)? What's the difference, and, if you do want a programmable logic controller, what designates a "micro PLC," and do traditional monikers still apply?

It may be that the functionality a controller brings from automation design through implementation, use, repair, and upgrades is more important than the type of controller. As for size, all bets are off on traditional measures such as input/output (I/O) count; just get the functions needed for the application, perhaps with a bit more for any possible expansion.

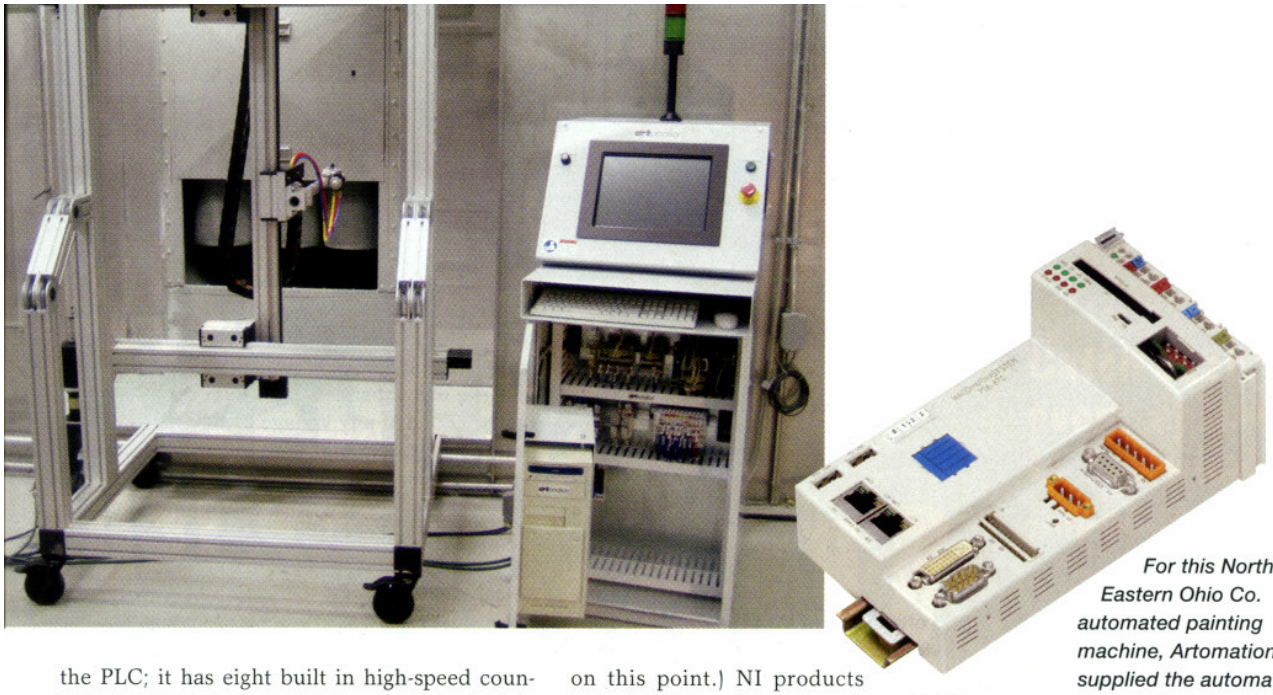
In general PACs are PLC-like in form factor and function with industrially hardened PC-based logic and capabilities, more open, with easier, built-in communications, and often with more programming flexibility than PLCs.

Even so, PLCs have continued to advance in ease of use, communications, and other functionality. Mid-year 2004, ARC Advisory Group noted, "PLCs have now become so much of a commodity that suppliers of PLCs often do not know the end use of the nano- and micro-PLCs that they sell through distributors." *Control Engineering*'s November 2004 PLC research (to be updated in the December issue) noted, "Micro and medium are the most widely installed types of PLCs."

Small-sized PLCs pack in features unheard of a few years ago, suggests Sydney Brooks, senior technical support specialist, Panasonic Electric Works Corp. of America (formerly Aromat, NAiS). The new compact FP-X brick-style PLC, for instance, has I/O cassettes that stack atop



Telemecanique Twido Nano PLC from Schneider Electric controls these conveyor and packaging lines in a fruit and vegetable plant.



For this North Eastern Ohio Co. automated painting machine, Artomation supplied the automation system, including Wago I/O modules and Ethernet-based Micro PLC.

the PLC; it has eight built in high-speed counters, for encoders, proximity or photoelectric sensors, compared to competitors that have two, on average, Brooks said.

As with other PLCs, "Most micro PLCs have adopted the IEC 61131-3 programming standard, which defines a standard instruction set, datatypes, and programming environment," explains Mark DeCramer, Wago product manager, advanced electronics. Often-covered advantages include reusable code, processor-independent programming, code portability across PLC brands, and, DeCramer suggests, a faster learning curve. "If you're not using a micro PLC supported by IEC 61131-3 programming, the money you're saving on your micro PLC hardware is being spent elsewhere on excessive engineering and training costs."

PAC, PLC, or both?

The application should help determine if a PLC or PAC (or both) should be used, suggests Gricha Raether, data acquisition product manager, National Instruments.

"Today's control processes rely on myriad signals and data, ranging from analog and digital I/O devices to high-resolution, high-speed cameras, and multi-axis motion controllers," Raether says. "Applications like high-speed production, real-time machine condition monitoring, high-precision control, and complex process control require high-speed data acquisition, advanced analysis, and processing algorithms to be executed deterministically."

High-end PLCs, he admits, can satisfy some of these requirements, but "engineers need computational resources, such as floating-point processors and substantial memory, to handle these signals efficiently. PACs integrate this off-the-shelf hardware with a real-time operating system to provide a cost-efficient platform for control engineers." (See online sidebar for more on this point.) NI products include PACs and logic boards, not PLCs.

When selecting a smaller PLC versus a larger PAC, says Tim Roberts, staff product specialist and team leader, low end control products, Schneider Electric, "consider the size and breadth of the application, and determine if the smaller PLC like a 'nano PLC' is suitable. A nano PLC can be an option for complex machine applications while a PAC is usually the preferable option for complex processes." Roberts says, "If a smaller PLC is suitable for the application, then determine if the PLC has adequate I/O count (discrete and analog), PID loops, adequate memory, communications capabilities, and processing speed that is fast enough. Physical dimensions should be a consideration as well if space is an issue." Applications show advantages and adaptability of today's small controllers.

Automated painting

North Eastern Ohio Co., an OEM of automated painting machines, required near real-time coordination of multi axis motion with digital and analog outputs. The prior setup included a motion card and I/O card(s) installed in a Real Time Unix-based industrial PC. Code resided in the PC and on the motion card.

The upgrade needed to maintain the existing motion platform because of an installed base, and it added I/O-based logic that could independently operate non-robotic functions, like paint filling. The new application combined an Ethernet-based stand-alone motion controller, Microsoft Windows PC, and Wago Ethernet Programmable Field Bus Coupler. Artomation By Digital Coating Devices Inc. supplied and integrated the controller/HMI; Chuck Greene, vice president, product development, outlined benefits in this application:

- Motion controller was same manufacturer so motion software didn't change.

AT A GLANCE

- **Faster, smarter, lower cost**
- **I/O count isn't accurate for PLC 'size'**
- **More features per cubic inch**
- **Focus on functions, not names**

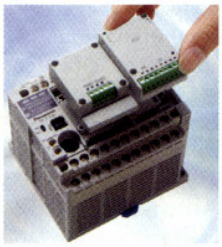
Old measures for PLCs fall away with new technologies

I/O counts were among traditional measures for PLC sizes cited in the past.

Old	Older
Nano: Less than 15 I/O points;	Nano: 0-64 I/O points;
Micro: 16-128 I/O points;	Micro: 65-128 I/O points;
Medium: 129-511 I/O points, and	Medium: 129-256 I/O points; and
Large: 512 and more I/O points.	Large: 256 or more I/O points.

However, today's "smallest" PLCs often exceed I/O capabilities of yesterday's "large" PLCs, so it's best to look for needed functionality rather than I/O-based size, experts say.

GE Fanuc VersaMax Micro Nano PLC fits in operational environments where panel space is limited but high volume production and processor speeds are required. With all-in-one construction, this compact PLC provides up to 64 I/O points (expandable to 176), fast cycle times, a robust instruction set, and extensive memory to multiply programming options. Modular design is said to allow flexibility and easy installation.



Panasonic Electric Works Corp. of America offers FP-X, with a set of features and functions said to rival all competitors. With processor speeds of 0.32 µs and 32-K program memory, FP-X can replace small and expensive high-speed PLCs. FP-X comes with built-in 24-V sensor power supply, removable terminal strips and relay outputs. It's ac-powered and offers communication, analog and discrete I/O points, and motion expansions. FP-X also can use all expansions available for the FP0 series PLC.

Allen-Bradley MicroLogix 1100 controller from Rockwell Automation offers a cost-effective, low-end controller with the flexibility of online editing. List priced at $550, the new controller helps users modify programs, including PID (proportional integral differential) loops, while online. Embedded EtherNet/IP communications port shares data across a production facility and eliminates network wiring. An embedded Ethernet Web server gives users remote access to control information. Applications include distributed control across an Ethernet network, such as in material handling or packaging applications, and supervisory control and data acquisition, with the controller as a remote terminal unit. Built-in, multipurpose text LCD screen may eliminate need for a separate operator interface in many applications.

Telemecanique Twido nanoPLC from Schneider Electric has capabilities that many larger PLCs do, but in a smaller package. With multiple communication capabilities, it is said to be a "very powerful product for its size," with "the fastest cycle times per instruction logic."

■ Microsoft Windows PC cut the cost of PC by more than 50%.

■ Wago I/O connections provided direct communication to motion using Modbus protocol. Cost of I/O modules fell 10-20% for standard equipment and as much as 40% on machines that require expanded I/O connections, which can be added at any voltage in the field, using a power feed module. Communications to multiple field devices included RS-485.

"We were able to write a configuration utility that allows us to add I/O points without re-writing software. Simply configure and go," Greene notes. Wago 842 PFC (programmable field controller) uses IEC 61131-3 standard programming and functions on its own. "Motion communicates via Modbus to notify I/O devices which process to run. I/O runs process independently of motion and PC, allowing the operation to load paint, test spray gun setup, etc." For applications that don't require motion, the Wago controller functions on its own; using a specialty module it reads an encoder on the conveyor and triggers the correct guns on or off as parts move by.

Wastewater express

Standing water is not something that you want to see or smell while waiting for your train (or working in an industrial environment). Better to ensure any runoff "takes the express" to an appropriate location. Toronto Transportation Co. (TTC) has installed ITT Flygt's Logimac PLC-based pumping systems at all of its stations, after seeking to standardize controllers. ITT Flygt Canada sought reliable, cost-effective powerful control, with flexible communications, and strong service and support.

Designed for use with duplex, triplex, and quadruplex pumping stations, a Logimac system includes a PLC running a standard industry-specific program that ITT Flygt Canada developed for identification of faulty equipment and safe and reliable operation of the pumping station, and an operator interface. The system monitors and controls overheating of the pump motor stator and ball bearings, liquid infiltration inside the pump motor stator and pump junction box, and detection of faulty level regulators. It also monitors inputs, including switches or pressure sensors that measure incoming flow volume. If wastewater surpasses a pre-determined level, the PLC sends a command to one or more pumps to begin pumping to a treatment plant.

"The Logimac system is powerful enough to calculate pumped volume based on incoming flow," says Luc-Réjean Lepine, product manager, ITT Flygt Canada. "By automatically bringing more pumps into operation when needed, the

ONLINE

Read this article at www.controleng.com/archive, September 2005, for more application details, photos, commentary, products, and related reading. At www.cesuppliersearch.com, 61 companies are listed under "Programmable Logic Controllers (PLC), Micro."

system prevents overflow of untreated wastewater to the rivers, enabling better wastewater treatment." Lepine says GE Fanuc's micro PLCs benefit ITT Flygt Canada and its customers. Currently used VersaMax Micro PLC is expandable up to 84 I/O points and used with variable-frequency drives and soft starters. "These controllers are powerful, reliable, and cost-effective," Lepine says. "They are also easily customizable, which is important to us and our customers." Industry-standard, easy-to-use programming also enables ITT Flygt Canada to commission pumping stations quickly. **ce**

For more information on companies mentioned in this article, visit www.controleng.com and the sites below.

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www.gefanuc.com
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www.telemecanique.com (Schneider Electric)
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www.wago.us

EXCLUSIVE PLC control: Full House Co. cuts door/jamb machine downtime, boosts production

Fred Braid of Full House Co. says that not much has changed in the door machinery industry since his father pioneered pre-hung doors. In fact, machines controlled by relays, valves, and compressed air are the standard for Braid's customers and competitors alike.

In 2004, however, Braid broke nearly 70 years of pneumatic-control tradition with the Marquise Diamond, Full House's first PLC-controlled, servo-driven door-and-jamb machine. Braid's goal was to build a machine that would carry on the company's mission: designing equipment that helps door companies increase profits by streamlining production and reducing labor costs. Braid and the Full House engineering team worked with Siemens Energy & Automation through the transition. Goals included increased precision, improved product quality, and flexibility to quickly and easily change setup parameters for door and jamb products.

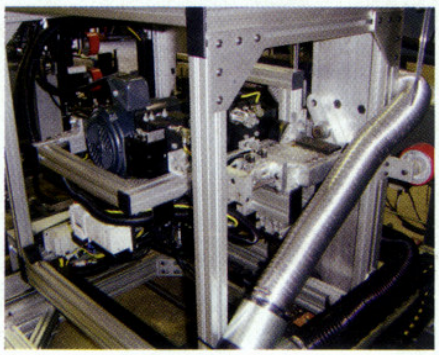
"What we wanted to accomplish with the new machine would have been very complicated with traditional pneumatic logic," Braid says.

Full House chose Siemens Simatic S7-200 PLC programmed with MicroWin software to keep the company ahead of the competition that continued to offer only pneumatic control machines. Marquise Diamond Door & Jamb Machine's high production rate (60 doors per hour) offers door manufacturers high levels of quality and versatility when machining wooden and fiberglass doors up to 8-ft high and 4-ft wide. Setup can be changed in seconds with a Siemens Simatic TP-270, a 10-in., touchscreen HMI programmed with Siemens ProTool Pro software, compared to the normal one-hour changeover time on pneumatic models. Sean Morgan, Full House development engineer, praised the flexibility of being able to reprogram and change-out parts, technical support, and service. S7-200 PLC controls all operations of the Marquise Diamond via an AS-interface, a multi-vendor bus system that transfers process- and machine-level digital and analog signals. Data and supply voltage are transmitted over a two-wire cable. It eliminates more costly parallel wiring, offers flexibility for add-on features, and has plug-and-play functionality, Morgan says, helping installers with mechanical backgrounds. Because of the bus system, features can be added without wiring changes.

PLCs reduce maintenance, simplify operation, and decrease service calls and downtime compared to Full House pneumatic machines. Braid says, "No longer are air quality issues, incorrect air pressures, and water in the system causing problems. Also, we can perform diagnostics and control the machine over the Internet," obviously better than sending a service technician overseas.

"The Marquise Diamond takes a door slab and machines it for the hinges and bores it for the lock," says Carl Oberg, Full House production manager. "If the hinge locations are off or the door lock is off, poor quality results. Consistency is key. If a problem does arise, it is corrected much faster with the PLC than with pneumatic control."

Braid says the HMI reduces labor and material costs by decreasing time for changes or to correct problems. Hinge and lock changes take seconds rather than the hour for pneumatic machines. Special orders, Oberg added, often "required running a door through a machine twice. That could take up to seven minutes." It's now less than one.



Full House Co. uses Siemens Simatic S7-200 PLC on its Marquise Diamond Door & Jamb Machine and plans to expand to other machines, because of faster changeovers, higher quality, and better reliability compared to pneumatic systems now in use.